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Selection, termination, and longterm funding of educational projects are each discussed in terms of relevant economic considerations. Planning a project requires manipulation of the variables time, cost, performance, and reliability, to obtain the best results whenever constraints are placed on one or more of the variables. A major difficulty with project termination, which should be done when further investment yields no positive results, is establishing procedures for the termination. In longterm planning, it should be recognized that research costs are only a small part of the total costs of a successful project. The research-development-production sequence generally shows an ever increasing curvilinear relationship in terms of cost. (HW)

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# SOME ECONOMIC CONSIDERATIONS IN EDUCATIONAL PROJECT PLANNING*

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## Introduction

Several years ago a colleague in presenting a paper at a convention described it as a "Simple-minded approach to a trivial problem". There were times during the process of preparing this paper that a similar feeling came to me with regard to the substance of what I would like to present to you this afternoon. Second thoughts, however, convinced me that the substance is not a trivial problem nor are there really simple-minded approaches to it. To some extent, the majority of my remarks may be old hat to this audience in view of the wide experience many of you have in project planning. To you, the substance will seem trivial and the approach simple-minded. My experience reveals, however, that there is a large audience which is not here and does not possess the background that you do. The substance presented may provoke a great deal of thought within that audience.

The general thesis that I would like to pursue is that a fairly large number of persons in the field of education do not give sufficient thought to the economic function in the process of project planning. The economic function referred to here is more simply expressed in terms of "costs" or still more simply "dollars". It is my contention that more attention must be given to this function in project planning since the funding agencies and the agencies receiving the funds are both working within the "limited resource"

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EA 001 791

case. Insufficient attention to the economic function in planning projects may create problems for both agencies, a point to which I will return later.

The focus of my remarks will be primarily upon those activities commonly called projects. In general, projects are activities which are goal oriented, finite in duration, nonrepetitive in nature, and consist of a series of parellel and linear tasks which are accomplished by the application of resources (men, money, materials, etc.). We will consider the project to be a system and therefore amenable to many of the principles and concepts of a system; (e.g. system analysis, system design, and related concepts).

Time does not permit a detailed presentation here of the conceptualization of the project as a system. Persons interested in this idea should read the paper the author presented at the Operations Analysis in Education Symposium sponsored by the U. S. Office of Education in November, 1967 (2). Although focusing upon projects, much of what I want to say can be equally applied to efforts commonly called programs.

The problem of economic functions in project planning is highly related to a topic receiving increased attention in the field of education at the present time - that of cost/utility or cost/effectiveness. As noted above, we are almost always operating under the limited resource case and are therefore highly interested in making sure that, for the dollars expended, worthwhile results are being secured.

Time does not permit a complete discussion of the problem before us, so I have selected out only three general areas for discussion. These are economic considerations in (a) project selection, (b) project termination, and (c) long-term funding.

Economic Considerations in Project Selection.

As a preface to the point I would like to make under economic considerations

in project selection, let me present two related points.

A major consideration in any discussion of project planning is a recognition of the fact we must always be concerned with the three variables of time, cost, and performance.

A fourth variable, reliability, is often identified as one of the major variables of concern. Reliability here means that the systems produced maintains a consistent performance over time. For example, we might meet performance standards by achieving gains in academic achievement as a result of a new program developed through a project but the gains do not remain over time. In this case, we would have achieved our performance standards but they would not be reliable. For our discussion here, the concept of performance includes this variable of reliability.

Each of these three variables can be considered as being independent of each other but at the same time having important interrelationships to the extent that constraints upon any one have an important effect upon the others. For example, if a constraint is upon time, or schedule, then the project planner is free to manipulate only the other two. If the constraint is upon cost, then he can manipulate only time and performance. Recognition of the interaction of these variables leads to at least three conditions under which a project planner might possibly have to operate.

1. In one condition, there is a specified level of performance to be achieved (output, product quality, etc.). In this situation, the project planner must determine the most economical combination of resources which give a high probability of attaining the stated objectives. This situation often occurs when responding to an RFP from a funding agency.
2. In a second condition, there is a specified limit on available resources and an open-ended output objective. In this situation,

the project planner has to combine the limited resources in such a manner as to maxim.ze the output achieved from them. This situation often occurs in certain RFP situations when a dollar amount may be fixed or in some situations which contain dollar restrictions.

3. A third condition is a combination of the first two in that there is a specified amount of resources available to attain a speicified output. In this instance, the project planner has little control, perhaps even none, over requests for funds or what he is required to produce. This situation again often occurs in RFP situations where both dollar amounts and performance output are specified. In the above three cases, we are concerned with the effective and efficient uses of resources under constraints that may be operating in a specific project situation.

A second major point to be kept in mind centers around the idea that in perhaps the majority of cases in education, and perhaps most particularly in the cases of the unsolicited proposal as opposed to a proposal responding to an RFP, any project plan developed is usually an ideal plan". This ideal plan focuses primarily upon the output or performance variable. Consequently, most of the initiator's time and effort is spent on problem statements, objectives, procedures and data analysis. Less time is spent on thinking through the time and cost dimensions except insofar as they are needed to achieve the performance objectives. The economic function or role that the project planner has in these situations is often not considered. This situation is perhaps not too unusual since the project planner is most often a substansive specialist who has had little or no experience with the management function. Therefore, he is not likely to be overly concerned with <u>alternative</u> plans that might be developed which give equal attention to the three variables of time, cost, and performance.

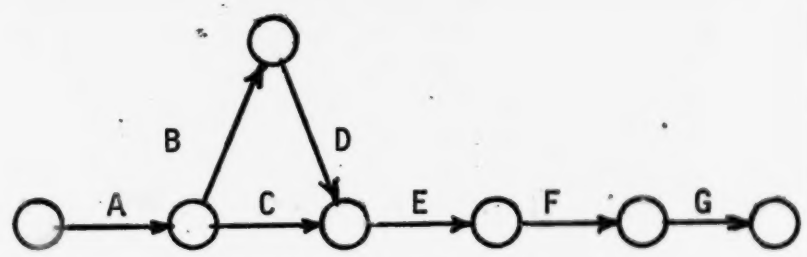
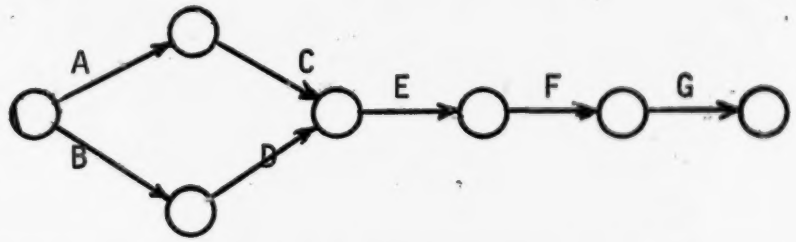
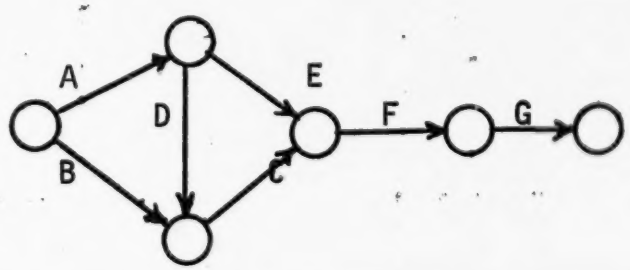
In short, the concern is primarily with maximizing the performance variable and not with the most economical combination of resources. Hence, the decision-maker (i.e. the funding agency) is not able to choose between alternatives and, therefore, is not in a position to make most efficient use of the dollar.

With these two points in mind, let us now turn to a behavior that a project planner might exhibit as he undertakes to develop a proposal where attention is given to all three variables rather than to just one - that of performance. The behavior is that of developing alternative time, cost, performance plans and not just simply an ideal plan.

The basic idea to be presented derives from some early thinking associated with the development of the PERT/COST system (5). For those persons unfamiliar with the basic nature of PERT (Program Evaluation and Review Technique), it is recommended that they read the monograph prepared by the author for the U. S. Office of Education (3). The specific idea presented in this system was that time-cost-performance options could be developed by the project planner. The essence of the procedure is presented in Figure 1.

In this figure, three different alternatives or options are considered with regard to the same project. Under Plan A there is a sequence of jobs which perhaps represent the ideal situation since the risks involved are relatively low but the time is rather high, In Plan B it can be seen that certain activities formerly performed in an ideal order have now been placed in parallel. The net effect on the three dimensions is to reduce the time but to increase the costs and to generate a larger degree of risk with regard to performance. In Plan C the network configuration has been further modified with time reduced but costs increased and greater risk introduced with regard to performance. The principal point to be made with regard to this illustration is that when we maximize one variable, there is an important effect upon the others. At the same time, we can study the possible alternatives available to

Figure 1. Time-Cost-Performance Alternatives in Project Planning

| Plan | Network Configuration | Time | Cost | Performance Risk |
|---|---|---|---|---|
| PLAN A |   | 2 years | 35,000 | Low |
| PLAN B |   | 1½ years | 55,000 | Medium |
| PLAN C |   | 1 year | 75,000 | High |

us as we develop project plans.

What I would like to emphasize here is that in most cases persons in the field of education develop proposals primarily on the basis of what might be considered as the ideal plan, or what I have chosen to call Plan A. It has been my experience in helping educational personnel to prepare proposals or plans that very few of them approach the situation in terms of consideration of alternatives such as those exhibited in the illustration. Therefore, when asked to prepare proposals under certain constraints, and most particularly economic or cost constraints, proposal initiators or planners tend to follow previous behaviors by trying to maximize the performance dimension - or to come up with the ideal plan.

If asked, perhaps many of my educational colleagues would concur with the idea that we should go with Plan A as illustrated since it is the <u>lowest cost</u> figure and performance risks are minimized. Overlooked in this decision is the fact that personnel resources are tied up for a much longer period of time than is the case in the other two alternatives. Tying up personnel and other types of resources does have an economic impact on the organizational unit conducting the project in that these personnel and other resources are not available to carry out other functions of the organization. This problem is sometimes overcome by the use of institutional contributions to defray the cost of replacement personnel. This procedure seems efficient until one considers that the replacement personnel often do not have the skills and competencies of persons actually working on the project. The committment of professional personnel to the project over a long period of time may mean that some classes of courses have to be suspended until the project is finished, which also has its economic impact in terms of students being unable to secure courses and thus completing their degrees on schedule.

Those of you familiar with project planning and selection procedures in business and other governmental areas perhaps recognize that, in many cases, personnel planning projects are asked to develop alternative plans showing time, cost, and performance dimensions so that more effective decisions can be made with regard to allocation of limited resources. In some cases, the desirability of having the final product or output available early will outweigh the economic or cost factors, even though the final product may be produced under a high risk condition. I would suggest that if you have not read either the history of the Manhattan Project (4) or the Polaris submarine development that you do so since time was the major variable to be considered in both ventures. The plans followed were selected primarily upon the need to have the final item available as early as possible under circumstances of a great deal of uncertainty as to what the end product might look like or if it would ever function properly.

The question might be raised - Do we have similar kinds of situations in the field of education? It would be my belief that at the present time we do. There are some situations in education that cannot wait until the "ideal project plan" is carried out. The problems are too urgent to follow the linear model of research, development, dissemination, and reduction-to-public practice. We may have to recognize that some of these steps will have to be skipped in our planning effort. In so doing, we may have to expend <u>resources</u> at a greater effort than desired, accepting the performance risks involved so that we can begin to deal with the problems before us. We may, therefore, have to choose Plan C among our alternatives rather than Plan A. To make our decision, however, we must establish our objective. That is, are we going to insist upon maximized performance? Minimized costs? Minimized time? If our objective is to secure a result as quickly as possible

then we will probably go with Plan C, accepting the additional costs and performance risks as part of our decision. If we put a cost constraint upon our project equal to that shown in Plan A, then that is the choice which we will accept. In either case, we need to establish our objective before deciding upon an acceptable plan.

One major limitation, however, accompanies our operating in this manner. That limitation is that the alternatives with regard to time, cost, and performance are not known or available to the decision-maker because they are not simply generated. Perhaps what we should begin to do is to ask persons preparing proposals or plans for funding by educational agencies, such as the U.S. Office of Education, to present to these agencies alternative plans which can be considered. In one sense, this idea is being implemented at the present time, but only indirectly. For example, there would not be much doubt in my mind that a variety of proposals presented to USOE in response to an RFP do represent in effect, alternative plans which reflect different combinations of time, cost, and performance. As far as I know, no one has researched this area to determine to what extent this is true. The idea is also being implemented to some degree in the regional educational laboratories by asking that budgets be submitted which reflect accomplishment under optimum budgets, normal or maintenance budgets, and reduced funding levels. It should be noted here that the variable being manipulated is basically one of cost or dollars.

Considerations in Project Termination

In addition to the problem of deriving alternatives for project plans which reflect possible time and performance factors for costs involved, consideration must also be given to the economics involved in project termination. No one likes to have the responsibility for terminating the work of a professional

person once under way. It is important to recognize, however, that the situation might well arise where further investment of dollars into a project where results are not forthcoming may be the best decision that can be made. Continued support of such a project acts as a drain on the limited resources available and prevents the organization from using these funds to support a different project where results might be more fruitful. Further, changes in objectives and the allocation of resources or dollars to these objectives would result in the termination of projects. I am sure you and I can both cite instances in the military complex where both of these factors of lack of success and changes in objectives have resulted in project termination . From my own experience, there is only a limited number of cases in the educational situation where a project once funded has been terminated for either of the above factors. It would appear to me that if most effective use is going to be made of the large but limited amounts of Federal funds available for educational research and development, then we must give greater attention to the problem of project termination as a means of making better allocation of these scarce dollars.

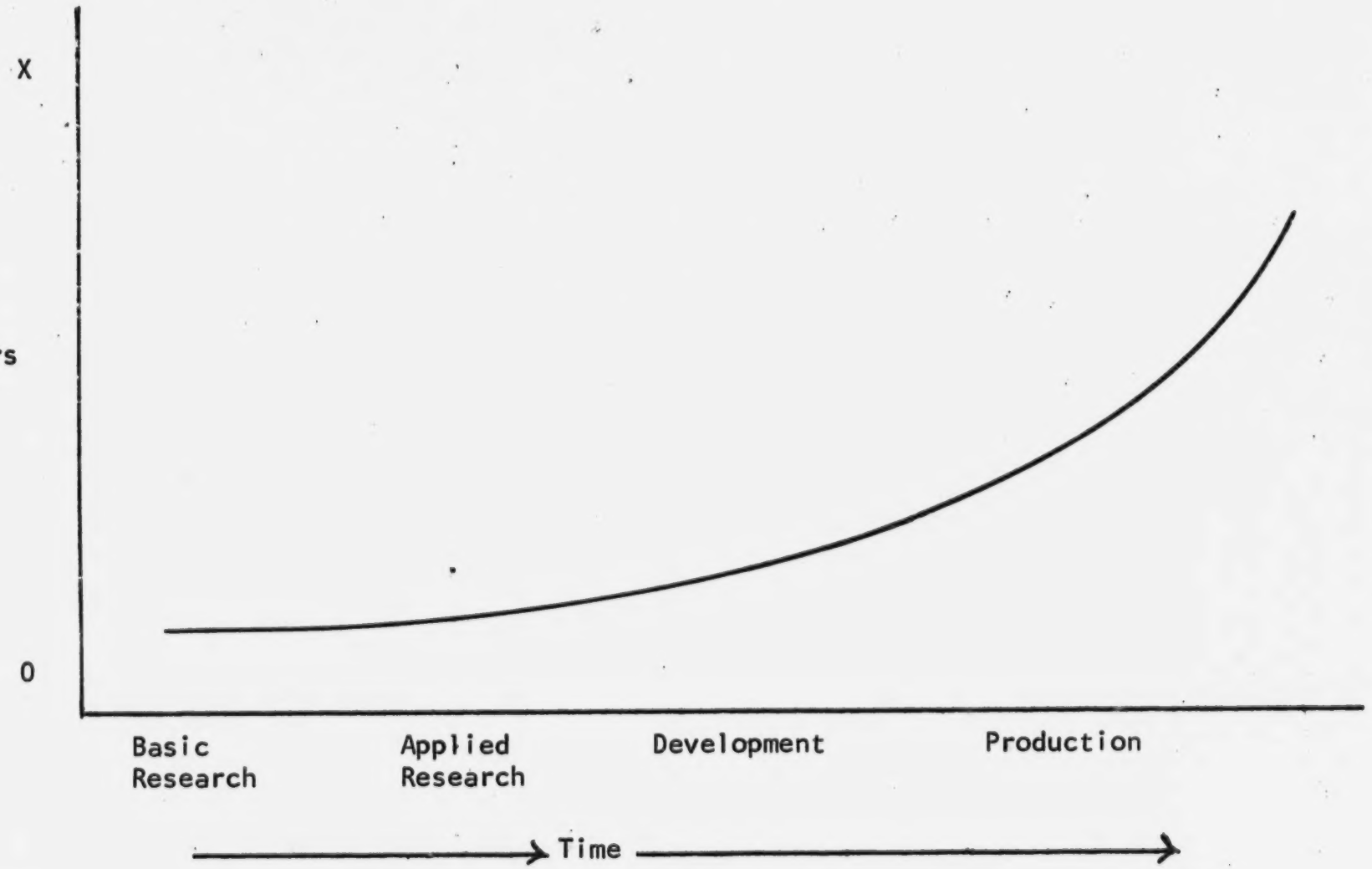
A major problem here is establishing procedures for terminating projects which are not producing useful results. Buell (1) has outlined some of the questions which might be asked about a project before such a final decision is made. One procedure that also might be utilized is the "milestone report" system. Certain major accomplishment points, or milestones, are identified at the start of the project and the performance requirements stated in advance. Should there be a failure to reach the performance specifications, a decision might be made to terminate. For example, if a large-scale curriculum project is dependent upon the successful development of measuring instruments, the specifications for the instrument in terms of validity and

reliability should be established early. Once the instrument is developed, we might examine the obtained reliability and validity to see if the performance specifications had been met. If not, then we would have to consider what action would be taken? Continue with a less than desirable instrument? Put additional time and money into bringing it up to performance specifications? Cancel the balance of the project since we would not want to proceed with further investment when we have an idea that the results based upon a less than perfect instrument would not be too meaningful? There are problems associated with this procedure, particularly around the recruitment and retention of personnel if there is a possibility of the loss of funds midway through the project if performance specifications are not made. On the other hand, it does not make much sense to continue to spend scarce resources on what appears to be a non-useful result.

Considerations Centering on Long-Term Expenditures.

In addition to the selection and termination problems, there is a third economic consideration that I would like to discuss albeit briefly. This consideration centers around the idea that we must be aware of the long-term dollars that would be needed if a particular planned project effort is successful. Some time ago in a Congressional hearing, Charles Hitch (6) pointed out that the initial costs for the research relating to penicillin were relatively small. The subsequent costs for the development and laboratory production of penicillin, however, showed an ever-increasing curvilinear relationship as shown in Figure 2. The curve presented is a rather generalized curve designed to show that there is an ever-increasing cost figure associated with movement from basic research through development to reduction-to-public-practice. In actuality, there are different cost curves in the sense that as research costs tend to diminish over time, development costs

Figure 2 - Projected Long-Term Cost Curve



tend to increase. As development costs increase, then production costs increase. Thus, there is a series of overlapping curves between the several functions.

It is generally recognized in the military-business complex that development costs are always at a greater level than for the research phase. Consequently, attention is paid in the original projects planning phase to the possible long-term committment of funds if the research produces useful results. From my experience, I think that education is just beginning to recognize this fact of life. Unfortunately, some of my colleagues don't like what they see. For example, some object to the level of funding involved in support of the regional educational laboratories feeling that this money might be better spent in basic and applied research. The general nature of the regional laboratories and the purposes for which they were created will require quite high levels of funding simply because development costs are expensive. The lessons learned from the military-business complex regarding expanding development and production costs following successful research efforts should be in our mind as we make our decisions to fund a particular educational project or plan. In brief, long-term costs are more than that represented by the budget associated with a particular project plan.

One solution to this problem would be to request from project planners a projection of costs over time. The PPBS system provides a vehicle for making such projections. It is granted that in some cases, the projections might be not much better than "guesstimates" but even that projection would be useful to a funding agency in planning future expenditures in the event that a project is brought to successful completion.

Conclusion

In conclusion, let me say that the three ideas presented above with regard to economic considerations in project planning represent some of the

concerns we have in our Center. Solutions to the problems are of great interest to us. Business and the military have been working on solutions to the problem of most effective allocation of dollars as they relate to the three considerations presented in this paper. Operational Research techniques, dynamic programming, and heuristic models are being developed to make the decision process more efficient. Perhaps my remarks will stimulate each of you to begin to devote some time and energy to solving some of the problems involved so that the most effective use of the limited dollars available to us can be made as we proceed to plan those projects and programs which are designed to maximize the educational system.

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